

MEMORANDUM

DEPARTMENT OF TRANSPORTATION
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Date: February 1, 2002

To: John M. Unbewust, Chief Engineer

Signature on file

From: Mark A. Leonard, Staff Bridge Branch Manager

Subject: Mast Arm Signal Structures

In 1996 twenty-five overhead sign structures southwest of Denver were taken out of service due to wind-induced cracking of the structural steel. All of these structures had been designed in compliance with the AASHTO standard specifications. The specifications however, did not address dynamic wind loads or structural fatigue at that time. CDOT responded by redesigning its standards, taking dynamic wind loads and fatigue into consideration through the use of NCHRP Report 412. AASHTO responded to the nation-wide problems of this nature by rewriting its specifications, using the same NCHRP report. CDOT also responded by conducting a full inspection of all the Department's overhead sign structures. With publication of the new sign standard in December 1998, and the inspection effort, the situation has been stabilized for sign structures.

The redesign effort also included mast arm signal structures. This standard followed the overhead sign structures and was first published in October 2000. Implementation of the new mast arm signals has not gone as smoothly as the overhead sign structures. Although both the new sign and signal standards were more expensive to build, the additional costs for the new signal standard has not been borne exclusively by CDOT. A significant number of the signals constructed in CDOT's ROW are constructed and maintained by local agencies. Another difficulty is some local agencies have architectural standards for their signals that are not satisfied by CDOT's S-Standards. Redesigning the local agency standards to meet current AASHTO requirements results in additional costs, and project design time.

In response to these difficulties the following items are proposed to define the Department's position for implementing the new AASHTO specifications and to provide a smooth and reasonable transition to the new specifications.

- All new signals planned for construction before July of 2004 in CDOT's ROW and for federal aid off-system projects shall be designed in compliance with the current AASHTO specifications, except for Section 11 as noted below, and sealed by a professional engineer registered in the state of Colorado. Section 11 is the fatigue design portion of the *AASHTO Standard Specifications for Structural supports for Highway Signs, Luminaires and Traffic Signals*.
- The intent is to bring all new signal designs in compliance with Section 11 of the AASHTO specifications by July 2004; however, the Department will review the timetable before this date, utilizing information from other states and CDOT's signal inspection program, and may extend the phase in period.
- Signals constructed on CDOT ROW with local agency funding participation will have until July 2004 to come into full compliance with Section 11 of the AASHTO specifications. This includes both projects funded wholly, or in part, by a local agency.
- When approved by the Region Traffic Engineer to satisfy local architectural requirements local agencies placing signals in CDOT's ROW may submit for review custom designs instead of using CDOT's S-Standards. These designs shall be AASHTO compliant, as provided for above, and sealed by a professional engineer registered in the state of Colorado.
- Projects in CDOT's ROW without local agency funding participation and with mast arms fifty-five feet and less in length will have until July 2004 to come into full compliance with Section 11 of the AASHTO specifications. New signals on these projects with mast arms greater than fifty-five feet in length shall be in full compliance with Section 11.

- The Department will provide a regular inspection and inventory program for all signals in CDOT's ROW. The preliminary scope-of-work for this has been developed and released for review 11/21/01.
- The initial inspection frequency will be two years. After the first two years the results of the inspection and inventory program will be used to determine the appropriate inspection frequency to use in the future.
- The inspection and inventory program will be used to ensure the integrity of existing mast arm signal structures. The results of the inspection and inventory program will be used to determine the Department's future policy for upgrading existing structures. Until that time upgrading existing mast arm signals to comply with the current AASHTO specifications will typically not be required; however, if during the course of the signal mast arm inspection a structural integrity problem is discovered, that signal must be repaired or replaced in accordance with Staff Bridge recommendations. This repair must be made a priority for funding.

- In-kind replacement of existing signals pieces for emergencies (e.g., collision damage) will be allowed to reduce response time and prevent foundation replacement.
- Within an intersection, relocation and continued use of existing signal structures that do not otherwise require structural modification will be allowed.

- The Department will provide a single arm alternative to the current double arm, both in full compliance with Section 11. This standard was released for review 11/24/01.
- The Department will develop a single arm S-Standard for mast arms fifty-five feet and less in length that are not fully compliant with Section 11 by February 2002.
- The Department will utilize information obtained from other DOT's as they develop their standards for the new AASHTO specifications, to further economize the S-Standards.
- The Department will employ a consultant to thoroughly review the S-Standards, including foundation design parameters, and provide any recommendations on improving their economy.

Although the new AASHTO specifications have been under development since before 1996, many designers and local agencies were not prepared for their implementation. The hardest impacts have been to the budgets and schedules for projects that were established prior to the 2001 publication of the current AASHTO specifications. These impacts are primarily due to the fatigue portion of the AASHTO specification, Section 11. Phasing in implementation of Section 11 until July 2004 for local agency projects will help these existing budgets and schedules. This phase-in provides approximately three years since the 2001 publication of the AASHTO specifications for signal projects that were budgeted in the STIP based on the previous AASHTO specifications.

The allowance pertains only to Section 11 of the current specifications. New signal structures should otherwise meet the current AASHTO specifications. Previous versions of the AASHTO specifications are obsolete and previous versions of CDOT's S-Standards have not been maintained.

An inspection program is needed to ensure the safety of existing structures and new structures not in full compliance with Section 11 per the July 2004 phase-in allowance. After the 1996 incident involving twenty-five overhead sign structures, a full inspection was undertaken. This has not happened for signal structures. Regions 1 and 4 have independently conducted a one-time inspection, and a few problems have been found.

The Department's bridges are inspected on a regular basis. The resulting inventory is a valuable resource to the Department for safety, maintenance, and programming. Unlike bridges, the majority of overhead sign and signal structures are non-redundant and fracture critical, and consequently present a greater safety risk than most bridges. Overhead signs and signals represent a component of the State's infrastructure that I estimate is worth over \$60 million, however this is approximate given the absence of a complete inventory of all overhead sign and signal costs. The Department should have a regular inspection program for overhead signs and signals and maintain an inventory that helps the Department manage this significant infrastructure component.

The number of mast arm signals in CDOT's right-of-way is currently estimated at about 2500. Signals in CDOT's ROW that are maintained by local agencies may not be fully reflected. With this proposal all mast arm signals would be inspected within the first two years. After two years we would have an accurate inventory of the number, age and condition of the signal structures. The inspection cycle for the structures in better condition and with adequate fatigue details could then be lengthened beyond every two years, reducing the cost of the inspection program.

Signature on file

I concur _____

John M. Unbewust, Chief Engineer

_____ Date

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